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U.S. Application No. 10/816,913

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Currently amended) A ~~storage-unit~~disk array system connected communicably to a plurality of other ~~storage-units~~disk array systems each having a plurality of first hard disk drives on which data is stored, wherein each of said plurality of other disk array systems is arranged to receive and store data from a different respective information processing unit in response to commands received therefrom, each said information processing unit writing and reading said data to and from said corresponding one of said plurality of other disk array systems, said ~~storage-unit~~disk array system comprising:

a plurality of second hard disk drives on which data is ~~stored~~stored; and

a second storage controller including:

a first receiving unit that receives copies of first storage data and first identifiers from respective first storage controllers of said other ~~storage-units~~disk array systems, said first storage data being stored in a plurality of storage blocks created by logically partitioning a data storage area of said plurality of first hard disk drives, said first identifiers identifying the storage blocks;

a first operation controller that calculates an exclusive OR of the copies of the first storage data, with a correspondence established among the first identifiers, from the copies of the first storage data received by said first receiving unit from said other

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~~storage-unit~~disk array system; and

a first ~~storage-disk~~ controller that stores a calculation result of the exclusive OR, calculated by said first operation controller, into storage blocks of said second hard disk drives, said storage blocks of said second hard disk drives having second identifiers corresponding to the first identifiers, said second identifiers individually identifying a plurality of storage blocks created by logically partitioning a data storage area of said plurality of second hard disk drives.

2. (Currently amended) The ~~storage-unit~~disk array system according to claim 1, wherein all calculation results of the exclusive OR calculated by said first operation controller are stored on said second hard disk drives, said ~~storage-unit-disk array system~~ further comprising:

a second receiving unit that receives a calculation result of an exclusive OR between write data and the first storage data, as well as the first identifier that identifies the storage block in which the write data is to be written, from one of said other ~~storage-unit~~disk array systems, said calculation result being calculated by said other ~~storage-unit-disk array system~~ that receives the write data to said first hard disk drives from an information processing unit, said first storage data being stored in the storage block of said first hard disk drives in which the write data is to be written;

a second operation controller that calculates an exclusive OR between the calculation result received by said second receiving unit and second storage data stored in the storage block of said second hard disk drives identified by the second identifier corresponding to the first identifier received by said second receiving unit;

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and

a second ~~storage-disk~~ controller that stores a calculation result of the exclusive OR, calculated by said second operation controller, into the storage block of said second hard disk drives identified by the second identifier.

3. (Currently amended) The disk array system ~~storage-unit~~ according to claim 1, wherein all calculation results of the exclusive OR calculated by said first operation controller are stored on said second hard disk drives, said disk array system ~~storage-unit~~ further comprising, when said other communicably connected disk array system ~~storage-unit~~ is added:

a third receiving unit that receives a copy of the first storage data and the first identifiers from said added other disk array system ~~storage-unit~~, said first storage data being stored in the storage blocks of said first hard disk drives of said added other disk array system ~~storage-unit~~;

a third operation controller that calculates an exclusive OR between the copy of said first storage data received by said third receiving unit and second storage data stored in the storage blocks of said second hard disk drives identified by the second identifiers corresponding to the first identifiers received by said third receiving unit; and

a third ~~storage-disk~~ controller that stores a calculation result of the exclusive OR, calculated by said third operation controller, into the storage blocks of said second hard disk drives identified by the second identifiers.

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4. (Currently amended) The disk array system storage unit according to claim 1, wherein all calculation results of the exclusive OR calculated by said first operation controller are stored on said second hard disk drives, said disk array system storage unit further comprising, when said other communicably connected disk array system storage unit is added:

a fourth receiving unit that receives a calculation result of an exclusive OR between write data and the first storage data as well as the first identifier, which identifies the storage block into which the write data is to be written, from said added other disk array system storage unit, said calculation result being calculated by said added other disk array system storage unit that receives the write data to said first hard disk drives of said added other storage from an information processing unit, said first storage data being stored in the storage block of said first hard disk drives in which the write data is to be written;

a fourth operation controller that calculates an exclusive OR between the calculation result received by said fourth receiving unit and second storage data stored in the storage block of said second hard disk drives identified by the second identifier corresponding to the first identifier received by said fourth receiving unit; and

a fourth storage-disk controller that stores a calculation result of the exclusive OR, calculated by said fourth operation controller, into the storage block of said second hard disk drives identified by the second identifier.

5. (Currently amended) The disk array system storage unit according to claim

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1, wherein all calculation results of the exclusive OR calculated by said first operation controller are stored on said second hard disk drives, said disk array system storage unit further comprising:

a fifth receiving unit that receives, from one of said other disk array system storage units, a request to send the first storage data to be stored in said first hard disk drives of said one of said other disk array system storage units;

a first sending unit that sends a request to send a copy of the first storage data, which is stored in the storage blocks of said first hard disk drives, as well as the first identifiers that identify the storage blocks in which the first storage data is stored, to said other disk array system storage units other than said one of said other disk array system storage units;

a sixth receiving unit that receives the copy of the first storage data as well as the first identifiers from each of the other disk array system storage units other than said one of said other disk array system storage units;

a fifth operation controller that calculates an exclusive OR between copies of the first storage data and second storage data, said copies of the first storage data being the copies of the first storage data received by said sixth receiving unit from said other disk array system storage units other than said one of other disk array system storage units and corresponding to the first identifiers, said second storage data being stored in the storage blocks of said second hard disk drives identified by the second identifiers corresponding to the first identifiers received by said sixth receiving unit; and

a second sending unit that sends a calculation result of the exclusive OR

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calculated by said fifth operation controller, as well as the first identifiers, to said one of said other disk array system~~storage-unit~~.

6. (Currently amended) A method of controlling a disk array system ~~storage unit~~-connected communicably to a plurality of other disk array systems ~~storage-units~~ each having a plurality of first hard disk drives on which data is stored and having a plurality of second hard disk drives on which data is stored, wherein each of said plurality of other disk array systems is arranged to receive and store data from a different respective information processing unit in response to commands received therefrom, each said information processing unit writing and reading said data to and from said corresponding one of said plurality of other disk array systems, said method comprising the steps of:

receiving, in a second storage controller of said disk array system, copies of first storage data and first identifiers from a first storage controller of each of said other disk array systems~~storage-units, respectively, said first storage data being stored in a plurality of storage blocks created by logically partitioning a data storage area of said plurality of first hard disk drives, said first identifiers identifying the storage blocks;~~

calculating, in said second storage controller, an exclusive OR of the copies of the first storage data, with a correspondence established among the first identifiers, from the copies of the first storage data received from said other disk array systems~~storage-units; and~~

storing, by said second storage controller, a calculation result of the exclusive

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OR into storage blocks of said second hard disk drives, said storage blocks of said second hard disk drives having second identifiers corresponding to the first identifiers, said second identifiers individually identifying a plurality of storage blocks created by logically partitioning a data storage area of said plurality of second hard disk drives.

7. (Currently amended) The method of controlling a disk array system ~~storage unit~~ according to claim 6, wherein all calculation results of the exclusive OR are stored on said second hard disk drives, said method further comprising the steps of:

receiving a calculation result of an exclusive OR between write data and the first storage data, as well as the first identifier that identifies the storage block in which the write data is to be written, from one of said other disk array system ~~storage unit~~, said calculation result being calculated by said other disk array system ~~storage unit~~ that receives the write data to said first hard disk drives from an information processing unit, said first storage data being stored in the storage block of said first hard disk drives in which the write data is to be written;

calculating an exclusive OR between the calculation result and second storage data stored in the storage block of said second hard disk drives identified by the second identifier corresponding to the first identifier; and

storing a calculation result of the exclusive OR into the storage block of said second hard disk drives identified by the second identifier.

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8. (Currently amended) The method of controlling a disk array system storage-unit according to claim 6, wherein all calculation results of the exclusive OR are stored on said second hard disk drives, said method further comprising the steps of, when said other communicably connected disk array system storage-unit is added:

receiving a copy of the first storage data and the first identifiers from said added other disk array system storage-unit, said first storage data being stored in the storage blocks of said first hard disk drives of said added other disk array system storage-unit;

calculating an exclusive OR between the copy of said first storage data and second storage data stored in the storage blocks of said second hard disk drives identified by the second identifiers corresponding to the first identifiers; and

storing a calculation result of the exclusive OR into the storage blocks of said second hard disk drives identified by the second identifiers.

9. (Currently amended) The method of controlling a disk array system storage-unit according to claim 6, wherein all calculation results of the exclusive OR are stored on said second hard disk drives, said method further comprising the steps of, when said other communicably connected disk array system storage-unit is added:

receiving a calculation result of an exclusive OR between write data and the first storage data as well as the first identifier, which identifies the storage block into which the write data is to be written, from said added other disk array system storage

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~~unit~~, said calculation result being calculated by said added other disk array system~~storage-unit~~ that receives the write data to said first hard disk drives of said added other storage from an information processing unit, said first storage data being stored in the storage block of said first hard disk drives in which the write data is to be written;

calculating an exclusive OR between the calculation result and second storage data stored in the storage block of said second hard disk drives identified by the second identifier corresponding to the first identifier; and

storing a calculation result of the exclusive OR into the storage block of said second hard disk drives identified by the second identifier.

10. (Currently amended) The method of controlling a disk array system~~storage-unit~~ according to claim 6, wherein all calculation results of the exclusive OR are stored on said second hard disk drives, said method further comprising the steps of:

receiving, from one of said other disk array system~~storage-units~~, a request to send the first storage data to be stored in said first hard disk drives of said one of said other disk array system~~storage-units~~;

sending a request to send a copy of the first storage data, which is stored in the storage blocks of said first hard disk drives, as well as the first identifiers that identify the storage blocks in which the first storage data is stored, to said other disk array system~~storage-units~~ other than said one of said other storage units;

receiving the copy of the first storage data as well as the first identifiers from

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each of the other disk array systems storage units other than said one of said other disk array systems storage units;

calculating an exclusive OR between copies of the first storage data and second storage data, said copies of the first storage data being the copies of the first storage data from said other disk array systems storage units other than said one of other disk array systems storage units and corresponding to the first identifiers, said second storage data being stored in the storage blocks of said second hard disk drives identified by the second identifiers corresponding to the first identifiers; and

sending a calculation result of the exclusive OR as well as the first identifiers to said one of said other disk array system storage unit.

11. (Currently amended) A storage system disk array system comprising a plurality of first storage units disk array system each having a first storage controller and a plurality of first hard disk drives on which data is stored; and a second storage unit disk array system connected communicably to the first storage units disk array system and having a second storage controller and a plurality of second hard disk drives on which data is stored, wherein each of said first disk array systems is arranged to receive and store data from a different respective information processing unit in response to commands received therefrom, each said information processing unit writing and reading said data to and from said corresponding disk array system,

wherein in each of said first storage unit disk array systems comprises:

a first data sending unit that said first storage controller sends a copy of first storage data and first identifiers to said second storage unit disk array system, said

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first storage data being stored in a plurality of storage blocks created by logically partitioning a data storage area of said plurality of first hard disk drives, said first identifiers identifying the storage blocks, ~~blocks, and~~

wherein in said second ~~storage-unit~~disk array system, said second storage controller comprises:

a first data receiving unit that receives copies of the first storage data and the first identifiers from said first ~~storage-unit~~disk array systems;

a first data operation controller that calculates an exclusive OR of the copies of the first storage data, with a correspondence established among the first identifiers, from the copies of the first storage data received by said first receiving unit from said first ~~storage-unit~~disk array systems; and

a first ~~data-storage-disk~~ controller that stores a calculation result of the exclusive OR, calculated by said first data operation controller, into storage blocks of said second hard disk drives, said storage blocks of said second hard disk drives having second identifiers corresponding to the first identifiers, said second identifiers individually identifying a plurality of storage blocks created by logically partitioning a data storage area of said plurality of second hard disk drives.

12. (Currently amended) The ~~storage-system~~disk array system according to ~~claim 11~~claim 11, wherein all calculation results of the exclusive OR calculated by said first data operation controller are stored on said second hard disk drives,

wherein each of said first ~~storage-unit~~disk array systems further comprises:

a second data operation controller that, when write data to said first hard disk

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drives is received from an information processing unit, calculates an exclusive OR between the write data and the first storage data stored in the storage block of said first hard disk drives into which the write data is to be written; and

a second data sending unit that sends a calculation result of the exclusive OR calculated by said second data operation controller, as well as said first identifier that identifies the storage block into which the write data is to be written, to said second ~~storage-unit~~disk array systems, and

said second ~~storage-unit~~disk array system comprises:

a second data receiving unit that receives a calculation result of the exclusive OR, calculated by said second data operation controller, as well as the first identifier, from said first ~~storage-unit~~disk array system;

a third data operation controller that calculates an exclusive OR between the calculation result received by said second data receiving unit and second storage data stored in the storage block of said second hard disk drives identified by the second identifier corresponding to the first identifier received by said second data receiving unit; and

a second ~~data-storage-disk~~ controller that stores a calculation result of the exclusive OR, calculated by said third data operation controller, into the storage block of said second hard disk drives identified by the second identifier.

13. (Currently amended) The ~~storage-system~~disk array system according to claim 11, wherein all calculation results of the exclusive OR calculated by said first data operation controller are stored on said second hard disk drives,

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wherein said second ~~storage-unit~~disk array system further comprises:

a third data sending unit that, when said first ~~storage-unit~~disk array system connected communicably to said second ~~storage-unit~~disk array system is added, sends a request to send a copy of the first storage data stored in the storage blocks of said first hard disk drives, as well as the first identifiers that identify the storage blocks in which the first storage data is stored, to said added first ~~storage-unit~~disk array system.

said first ~~storage-unit~~disk array system further comprises:

a fourth data sending unit that, in response to the request to send, sends the copy of the first storage data stored in the storage blocks of said first hard disk drives, as well as the first identifiers, to said second ~~storage-unit~~disk array system.

said second ~~storage-unit~~disk array system further comprises:

a third data receiving unit that receives the copy of the first storage data, as well as the first identifiers, from said first ~~storage-unit~~disk array system;

a fourth data operation controller that calculates an exclusive OR between the copy of the first storage data received by said third data receiving unit and second storage data stored in the storage blocks of said second hard disk drives identified by the second identifiers corresponding to the first identifiers received by said third data receiving unit; and

a third ~~data-storage-disk~~ controller that stores a calculation result of the exclusive OR calculated by said fourth data operation controller into the storage blocks of said second hard disk drives identified by said second identifiers.

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14. (Currently amended) The ~~storage system~~disk array system according to claim 11, wherein all calculation results of the exclusive OR calculated by said first data operation controller are stored on said second hard disk drives,

wherein, when said first ~~storage-unit~~disk array system connected communicably to said second ~~storage-unit~~disk array system is added, said added first ~~storage-unit~~disk array system further comprises:

a fifth data operation controller that, when write data to said first hard disk drives is received from an information processing unit, calculates an exclusive OR between the write data and the first storage data stored in the storage block of said first hard disk drives into which the write data is to be written; and

a fifth data sending unit that sends a calculation result of the exclusive OR calculated by said fifth data operation controller, as well as the first identifier identifying the storage block into which the write data is to be written, to said second ~~storage-unit~~disk array system, and

said second ~~storage-unit~~disk array system further comprises:

a fourth data receiving unit that receives a calculation result of the exclusive OR calculated by said fifth data operation controller, as well as the first identifier, from said added first ~~storage-unit~~disk array system;

a sixth data operation controller that calculates an exclusive OR between the calculation result received by said fourth data receiving unit and second storage data stored in the storage block of said second hard disk drives identified by said second identifier corresponding to the first identifier received by said fourth data receiving unit; and

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a fourth ~~data-storage-disk~~ controller that stores a calculation result of the exclusive OR calculated by said sixth data operation controller into the storage block of said second hard disk drives identified by said second identifier.

15. (Currently amended) The ~~storage-system-disk array system~~ according to claim 11, wherein all calculation results of the exclusive OR calculated by said first data operation controller are stored on said second hard disk drives,

wherein each of said first storage-unitdisk array systems further comprises:

a sixth data sending unit that sends a request to send the first storage data to be stored in said first hard disk drives of said first ~~storage-unitdisk array system~~ to said second ~~storage-unitdisk array system~~,

said second ~~storage-unitdisk array system~~ further comprises:

a fifth data receiving unit that receives the request to send the first storage data from said first ~~storage-unitdisk array system~~;

a seventh data sending unit that, in response to the request to send the first storage data, sends a request to send a copy of the first storage data, which is stored in the storage blocks of said first hard disk drives, as well as the first identifiers that identify the storage blocks in which the first storage data is stored, to said first ~~storage-unitdisk array system~~ other than said first ~~storage-unitdisk array system~~ that has sent the request to send said first storage data;

a sixth data receiving unit that receives the copy of the first storage data, as well as the first identifiers, from each of said first ~~storage-unitdisk array system~~ other than said first ~~storage-unitdisk array system~~ that has sent the request to send

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the first storage data;

a seventh data operation controller that calculates an exclusive OR between copies of the first storage data and second storage data, said copies of the first storage data being the copies of the first storage data received by said sixth data receiving unit and corresponding to the first identifiers, said second storage data being stored in the storage blocks of said second hard disk drives identified by the second identifiers corresponding to the first identifiers received by said sixth receiving unit; and

an eighth data sending unit that sends a calculation result of the exclusive OR calculated by said seventh data operation controller, as well as the first identifiers, to said first ~~storage unit~~ disk array system that has sent the request to send the first storage data, and,

said first ~~storage unit~~ disk array system further comprises:

a seventh data receiving unit that receives a calculation result of the exclusive OR calculated by said seventh data operation controller, as well as the first identifiers, from said second ~~storage unit~~ disk array system; and

a fifth ~~data storage disk~~ controller that stores the calculation result of the exclusive OR, received by said seventh data receiving unit, into the storage blocks of said first hard disk drives identified by the first identifiers received by said seventh data receiving unit.